CLAIMS

We claim:

1. A seepage meter for quantifying the rate of groundwater seepage into surface waters, comprising:

a collection funnel having a body with a top, an open bottom, and a first side;

an ultrasonic flow meter having an inlet, an outlet, a flow tube in fluid communication with the inlet and the outlet, and at least two piezoelectric transducers adjacent the flow tube; and

a control module comprising a control component and a data collection component, the control module being attached to the body and in operative communication with the flow meter;

wherein the collection funnel and the ultrasonic flow meter are connected so that fluid may flow from the collection funnel to and through the ultrasonic flow meter, and vice versa.

2. The seepage meter of claim 1, wherein the collection funnel and the ultrasonic flow meter are operatively connected by a discharge outlet connected to the first side of the collection funnel.

3. The seepage meter of claim 2, wherein the top is angled relative to the bottom such that the first side is longer than a second side, and the discharge outlet is located proximate the top on the first side.

4. The seepage meter of claim 3, wherein the discharge outlet and the ultrasonic flow meter outlet further comprise valves.

5. The seepage meter of claim 4, wherein the valves are ball valves.

6. The seepage meter of claim 1, further comprising a probe located within the collection funnel.

7. The seepage meter of claim 1, wherein the collection funnel further comprises a port located on the top of the collection funnel.

8. A method of diagnosing submarine groundwater discharge, comprising the steps of:

placing a seepage meter in the seabed, the seepage meter comprising:

a collection funnel having a body with a top, an open bottom, and a first side;

an ultrasonic flow meter having an inlet, an outlet, a flow tube in fluid communication with the inlet and the outlet, and at least two piezoelectric transducers adjacent the flow tube; and

a control module comprising a control component and a data collection component, the control module being attached to the body and in operative communication with the flow meter;

wherein the collection funnel and the ultrasonic flow meter are connected so that fluid may flow from the collection funnel to and through the ultrasonic flow meter, and vice versa;

calibrating the control module and the ultrasonic flow tube; and

measuring and collecting data on the flow rate of the submarine groundwater discharge.

9. The method of claim 8, the seepage meter further comprising a discharge outlet connected to the first side of the collection funnel.

10. The method of claim 9, wherein the top is angled relative to the bottom such that the first side is longer than a second side, and the discharge outlet is located proximate the top on the first side.

11. The method of claim 10, the step of placing the seepage meter in the seabed further comprising pressing the collection funnel into the seabed so that the bottom is substantially parallel to a top surface of the seabed and the top is angled relative to the top surface.

12. The method of claim 9, wherein the discharge outlet and the ultrasonic flow meter outlet further comprise valves.

13. The method of claim 12, wherein the step of calibrating the control module and the ultrasonic flow tube further comprise the steps of:

closing the valves; and

taking a zero calibration measurement.

14. The method of claim 8, wherein the flow rate of the submarine groundwater discharge is measured and collected in both the forward and reverse flow directions.

15. A method of taking samples of submarine groundwater discharge, comprising:

placing a seepage meter in the seabed, the seepage meter comprising:

a collection funnel having a body with a top, an open bottom, and a first side;

an ultrasonic flow meter having an inlet, an outlet having a valve, a flow tube in fluid communication with the inlet and the outlet, and at least two piezoelectric transducers adjacent the flow tube;

a discharge outlet, having a valve, connected to the first side of the collection funnel and operatively connecting the collection funnel and the ultrasonic flow meter;

a control module comprising a control component and a data collection component, the control module being attached to the body and in operative communication with the flow meter; and

a port in the top of the collection funnel;

closing the valves; and

opening the port and taking a sample of the submarine groundwater discharge from the funnel.

16. The method of claim 15, wherein the sample is taken by using a pump.

17. The method of claim 16, further comprising the steps of:

measuring the flow rate of the submarine groundwater discharge prior to sampling; and

using the pump to draw out the sample from the collection funnel at the measured flow rate.

18. The method of claim 17, wherein the pump is a manual peristaltic pump.